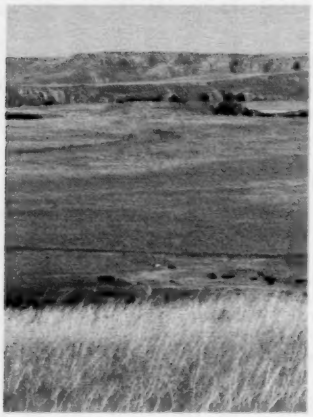
alberta's species at risk program

Prairie Falcon
Conservation Management Plan

2012-2017



Alberta Species at Risk Conservation Management Plan No. 9

Government of Alberta

Prairie Falcon

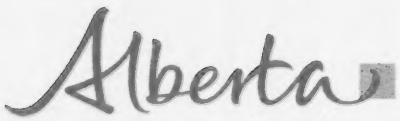
Conservation Management Plan

2012-2017

Prepared by:

Dale G. Paton

October 2012



Publication No.: I/471
ISBN: 978-0-7785-9990-6 (Printed Edition)
ISBN: 978-0-7785-9994-4 (On-line Edition)
ISSN: 1922-9976 (Printed Edition)
ISSN: 1922-9984 (On-line Edition)

Cover photos: Government of Alberta

For copies of this report, contact:

Information Centre – Publications
Alberta Environment and Sustainable Resource Development
Main Floor, Great West Life Building
9920 – 108 Street
Edmonton, Alberta, Canada T5K 2M4
Telephone: (780) 422-2079

OR

Visit the Species at Risk Program web site at:

http://srd.alberta.ca/FishWildlife/SpeciesAtRisk/

This publication may be cited as:

Alberta Environment and Sustainable Resource Development. 2012. Prairie Falcon Conservation Management Plan 2012-2017. Alberta Environment and Sustainable Resource Development. Species at Risk Conservation Management Plan No. 9. Edmonton, AB. 13 pp.

PREFACE

Albertans are fortunate to share their province with a diversity of wild species. A small number of these species are classified as Species of Special Concern because they have characteristics that make them particularly sensitive to human activities or natural events. Special conservation measures are necessary to ensure that these species do not become Endangered or Threatened.

Conservation management plans are developed for Species of Special Concern to provide guidance for land and resource management decisions that affect the species and their habitat. These plans are intended to be a resource tool for Environment and Sustainable Resource Development - Fish and Wildlife Division (ESRD-FWD) and for provincial and regional land and resource management staff.

Conservation management plans provide background information including species biology, threats to species and habitat, and inventory/monitoring history. Plans also provide a goal, objectives, and actions (management recommendations). Management recommendations are typically categorized into inventory and monitoring needs; habitat management and conservation; education and communication; and additional management considerations as required.

Conservation management plans are generally prepared by an ESRD-FWD biologist who has been designated as the provincial species lead. Writers from outside ESRD-FWD are occasionally sought to prepare plans for species for which there is little in-house expertise. In order to ensure accuracy and utility, each plan is reviewed by a species expert and a designated provincial representative from ESRD Forestry Division and/or Lands Division. In some cases there may be additional reviewers from staff, industry, and other agencies.

Conservation management plans are internal guidance documents. They are implemented under the guidance of the species lead and are "living" documents that can be revised at any time as required. Conservation management plans are more succinct than the recovery plans that are prepared for Endangered and Threatened species and do not involve participation of a multi-stakeholder team.

Conservation management plans are approved by the Director of Wildlife and/or Directory of Fisheries. Plans will be reviewed annually by the species lead and updated if necessary, and a more in-depth review will occur five years after a plan's approval.

TABLE OF CONTENTS

PREFACE.....iv

EXECUTIVE SUMMARY.....vi

ACKNOWLEDGEMENTS.....vi

1.0 INTRODUCTION.....1
- 1.1 Breeding Biology, Distribution, and Habitat Requirements.....1
- 1.2 Threats to the Population.....3
- 1.3 Provincial Monitoring History.....5

2.0 GOALS AND OBJECTIVES.....5
- 2.1 Goal.....5
- 2.2 Objectives.....6

3.0 MANAGEMENT ACTIONS.....6
- 3.1 Inventory and Monitoring.....6
- 3.2 Habitat Management.....7
- 3.3 Education and Communication.....8
- 3.4 Research.....8

4.0 SUMMARY.....9

5.0 LITERATURE CITED.....9

TABLE OF FIGURES

Figure 1. Prairie falcon breeding range in Alberta. 2

EXECUTIVE SUMMARY

The prairie falcon (*Falco mexicanus*) is a species of raptor found primarily on the prairies where it nests on riverine cliffs and coulees, hunting the open grasslands for ground squirrels and birds. The prairie falcon is designated as a *Species of Special Concern* in Alberta because of its small population size.

This plan recommends strategies to conserve prairie falcon populations and habitat, including: implementing efforts to assess prairie falcon population size; developing a method to monitor prairie falcon population trends; conserve nesting sites and grassland foraging habitat through guidelines and education, appropriate land practices, and land-use planning processes.

ACKNOWLEDGEMENTS

Several people reviewed the draft version of this plan and provided comments, including: Sue Cotterill (AESRD – FWD), Gord Court (AESRD – FWD), Lisa Wilkinson (AESRD – FWD), and Kevin France (AESRD – Rangeland).

1.0 INTRODUCTION

The prairie falcon (*Falco mexicanus*) has been designated a *Species of Special Concern* in Alberta because of its small population size (fewer than 1000 individuals) ESCC 2003). The most recent Federal assessment was in 1996, at which time the falcon was considered *Not at Risk* at a national level because the species is found in Canada as a relatively small population with no evidence of decline (COSEWIC 2011). It is federally protected under the *Migratory Bird Convention Act*.

The Alberta Endangered Species Conservation Committee's Initial Conservation Action Statement (2010) for prairie falcon determined the following:

1. Prairie falcon is identified as a 'Species of Special Concern' in Alberta, and
2. Sustainable Resource Development should develop appropriate mechanisms to identify and implement conservation and management of 'Sensitive Species' in general, which includes the prairie falcon.

This management plan addresses the second recommendation as it relates to the conservation of prairie falcons.

1.1 Breeding Biology, Distribution and Habitat Requirements

Prairie falcons inhabit hills, canyons, and mountains of arid grasslands and shrub-steppes of southwestern Canada and western United States. In Alberta, there are found primarily in the Grassland Natural Region (Figure 1). The prairie falcon is less migratory than some North American falcons; many, if not most, prairie falcons that breed in Alberta spend the winter near their breeding site. They move away from the northernmost and highest-elevation parts of the breeding range, likely based on avian prey availability (i.e., spring/fall seasonal ranges; Holroyd unpubl., Paton 2010). For those individuals that do migrate, they typically spend the winter in grassland habitats, mostly in the Great Plains, but also in areas west of the Rockies (Schmutz et al. 1991). A small number of individuals have been tracked to the same wintering area in consecutive years (Enderson 1964, Schmutz et al. 1991, Paton 2010).

The prairie falcon has a body length of 39–50 cm, a 1m wingspan, and weighs 700 -1200 grams. As in all falcons, females are noticeably larger than males. The prairie falcon is brown and has dark "armpits" or dark patches under the wings. The primary food is small mammals, especially ground squirrels, but they will also hunt birds, reptiles, and insects. Ground squirrels provide fat-rich calories that the prairie falcon requires for raising its broods during its 3 to 4 month nesting season. Timing of nesting closely parallels the chronology of ground squirrel populations (Fyfe 1997, Steenhof 1998). Prairie falcons arrive at nesting areas just as ground squirrels emerge from 6 months of estivation, and lay eggs when juvenile ground squirrels start to emerge from burrows. Prairie falcon young hatch when ground squirrel numbers are at a peak, and they disperse by the time that ground squirrels estivate in late August (Michener 1996).

Prairie falcons show high fidelity to nest sites; there are cases of nest sites in southern Alberta being used for decades (Fyfe 1997, Paton 1999, Campbell pers. comm.). Typically, prairie falcons nest on a cliff face using a ledge, cavity, crevice, or an abandoned nest of eagles, hawks, or ravens, laying 3 - 6 eggs with an incubation time of approximately 34 days. The young fledge 36 to 41 days after hatching and remain with the family group for a short time before dispersing. The prairie falcon is wide ranging during these time periods, hunting across large areas for patchily distributed prey. This falcon actively searches for prey during flight, catching prey on or close to the ground after a low angled swoop from above. It also pursues prey sighted from a perch, again often flying very low.

Reproductive rates reported in Alberta studies and from banding efforts (Fyfe 1997, Paton 2009, Campbell pers. comm.) are at or above the median replacement standard of 2.0 young/pair calculated by Runde (1987) as necessary to maintain a population through time. For most populations, including Alberta's, reproduction is tied to abundance of ground squirrels, which in turn is affected by periodic droughts (Fyfe 1997, Steenhof 1998). Reproductive rates could be misleading if considered in isolation of the number of territorial or successful pairs; adequate reproductive rates could occur among a declining number of successful pairs.

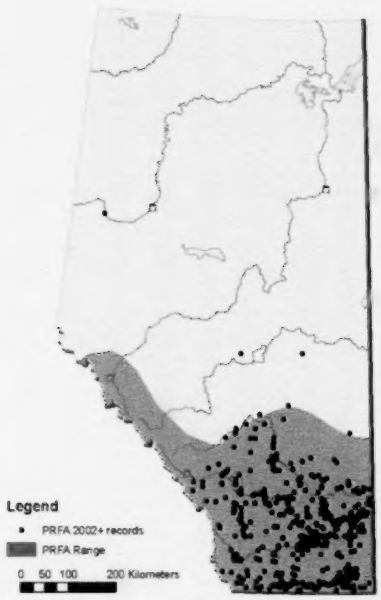


Figure 1. Prairie falcon breeding range in Alberta.

Population Status

In 1979, interviews with biologists from 17 U.S.A states, 3 Canadian provinces, and Mexico resulted in an estimate of 5,000–6,000 nesting pairs in North America (Steenhof 1998). The latest North America population estimation (Steenhof 1998) used state and provincial estimates and survey data from the late 1970's to 1991 to suggest a minimum population size for prairie falcons of 8,546 individuals of breeding age (4,273 pairs). Total population was estimated to be 13,000, based on number of individuals seen during Christmas Bird Counts (CBC) in the early 1980s (Butcher et al. 1987). In 1996 a Canadian federal government review suggested between 250 and 500 pairs nest in Canada (Kirk and Banasch 1996). The most recent provincial assessment in 2002 provided data of known occupied nest sites to support a minimum estimate of 200-250 pairs for Alberta which represents the majority of the population in Canada (Paton 2002). Data on population sizes were not available before 1950. In southern Alberta, researchers have noticed that the number of prairie falcon breeding pairs has decreased in some areas (Paton 2002, Campbell pers. comm.).

1.2 Threats to the Population

1.2.1 Habitat Loss and Fragmentation

Prairie falcons are largely found in the Grassland Natural Region of Alberta where approximately 75% of native prairie in Canada has been lost to human cultivation and settlement (Bradley and Wallis 1996), so available habitat is limited. Moreover, in Alberta, prairie falcons return to the same nest site 96% of the time (Fyfe 1997, Steenhof 1998), illustrating the importance of existing high quality nest sites. In comparison, prairie falcons do not usually the same nest site in subsequent years if nest sites are abundant (Idaho:Ogden and Hornocker 1977; Wyoming and Colorado: Enderson 1964, Squires 1986).

Prairie falcons are susceptible to habitat loss on breeding areas because nesting distribution is closely related to cliffs, or outcrops close to waterbodies (Steenhof 1998) where grasslands and sufficient prey are required. Because the number of nest sites in Alberta are limited (Bansch and Barry 1998, Paton 2010, Campbell pers. comm.), pairs cannot readily move to other undisturbed areas when nest sites or foraging habitats adjacent to cliffs are destroyed or degraded. Artificial nests sites have been created with good success in attracting breeding prairie falcons (Fyfe 1997, Campbell pers. comm.).

Human land development in the breeding range adversely affects prairie falcons, particularly in areas where populations forage on ground squirrels (Hunt 1993) with some population declines and loss of habitat noted post land-use change (Steenhof 1998, Kirk and Banasch 1996). In areas of human development, breeding individuals in Alberta selected native range habitat where ground squirrels were most abundant; their core use areas had lower proportions of irrigated cropland than expected based on availability (Hunt 1993). Computer simulations predicted that as little as 15% of agricultural conversion on the Snake River Plain would reduce prairie falcon productivity to a point where the population could not replace itself (Steenhof 1998).

Small-scale agricultural development, on the other hand, can benefit the Prairie Falcon when it provides an ecotone for prey populations. Irrigation canals provided foraging habitat in Alberta (Hunt 1993), and agricultural borders may provide important prey habitat during drought years in Idaho, when ground squirrels seek temporary refuge in irrigated lands (Marzluff et al. 1997). Small areas of agriculture interspersed with native rangeland provided habitat for prairie falcon prey in Montana, but both falcons and prey were rare in large tracts of monoculture crops (Harmata 1991). Livestock grazing practices that promote good range condition, maintain grassland processes and support species diversity are beneficial to prairie falcons.

Much of the habitat within the prairie falcon's home range is in demand for various types of non-renewable and renewable energy development. Depending on the circumstances and degree of disturbance, prairie falcons will adjust to some developments (Squires et al. 1993, Harmata 1991, Bednarz 1984, Phillips et al. 1990).

1.2.2 Disturbance at Nest Sites

Effect of human activity near a nest site depends on the nature of activity, proximity to the nest, duration and timing (Fyfe and Olendorff 1976). In general, pairs are more sensitive to disturbance during courtship and incubation than during brood-rearing and after fledging. Short, but intense disturbances can startle birds, causing them to flush and accidentally knock eggs from the nest. Disturbances of longer duration can cause a pair to abandon its nest (Fyfe and Olendorff. 1976). Pairs are usually tenacious in defending their nests against humans, but aggressive reactions are less common in areas with considerable human activity (Peterson 1988).

1.2.3 Pesticides

In 1968 and 1969, mercury residue concentrations in prairie falcon livers from Alberta were found to be high (Fimreite et al. 1970). Individuals ingested mercury when they fed on birds that had consumed mercury-treated seeds. However, mercury levels were not high enough to cause reproductive problems at the population level in Canada (Fyfe et al. 1976), and mercury contamination was not a problem in Montana (Harmata 1991). Fortunately the prairie falcon eats more mammals and fewer birds than the peregrine falcon and merlin do, and consequently the prairie falcon was exposed to lower amounts of organochlorine pesticides and did not experience severe population declines.

1.2.4 Rodenticides

Healthy ground squirrel populations are a key component of prairie falcon habitat. Consequently, excessive use of ground squirrel poisons (e.g., Chorophacinone and 2% Liquid Strychnine Concentrate (LSC)) could decrease prey availability (G. Court, pers. comm.).

1.2.5 Ingestion of Lead

Captive individuals can succumb to lead poisoning when they consume prey that have lead shot embedded in their tissues (Redig et al. 1980), but the extent of this problem in the wild is unknown. Lead levels in the blood of Montana prairie falcons were below that indicative of chronic or acute toxicity (Harmata 1991).

1.2.6 Climate Change

Climate change models predict an increase in severe weather events (e.g. drought and flooding) in areas such as the southern Alberta prairie ecosystem (Intergovernmental Panel on Climate Change 2001). Prairie falcons nesting in Alberta are on the northern limit of their continental range, thus their populations are small and vulnerable to environmental and habitat changes. Milder winters may reduce ground squirrel hibernation success, reducing prey availability for prairie falcons. The effects of these weather patterns may be limited to a local scale and their impact at a population level is unknown. The concern about a possible impact of climate change on hibernating mammals has also been discussed (Inouye et al. 2000). In the case of prairie falcons, if the seasonal changes affect its prey, and if seasonal cues are mismatched between the wintering and breeding grounds, this could become an additional factor negatively impacting the survival and reproduction of prairie falcons and other ground squirrel dependent raptors.

1.3 Provincial Monitoring History

Prairie falcons, particularly Alberta populations, have not been the focus of monitoring efforts since the 1970's. However, distribution and some nest occupancy data are collected during provincial surveys to assess peregrine falcon populations (e.g., Corrigan 2000). Population estimates are relevant to the conservation of species at risk, because status designations (e.g., Endangered, Threatened) are based, in part, on population size (International Union for Conservation of Nature 2001, Committee on the Status of Endangered Wildlife in Canada 2011).

Since the 2002 status report (Paton 2002), the short-term population trend in Alberta is difficult to ascertain due to limited current information. Using the most recent small-scale survey data as a basis for predicting, the population is stable with local declines (Hunt 1993, Fyfe 1997, Kirk and Banasch 1996, Paton 1999, Campbell pers. com.). Long-term trends will strongly depend on the conservation of native grasslands, cliff nest sites, prey species and management actions undertaken in Alberta.

2.0 GOALS AND OBJECTIVES

The following goals and objectives are based on the current information available regarding prairie falcons. They also reflect the common goals that are outlined in national recovery strategies to ensure that habitat requirements for sensitive grassland species are maintained in Canada (Environment Canada 2008).

2.1 Goal

Maintain, and increase if possible, current distribution and breeding populations of prairie falcons in Alberta.

2.2 Objectives

1. Inventory and monitoring: Develop and conduct monitoring program to track population trends, identify and prioritize potential risks to populations and habitat, and detect possible decreases in population.

2. Habitat management: Conserve and maintain remaining native prairie within the historical range of the species in Alberta through stewardship, beneficial land practices (timing and setback guidelines during critical time periods) and integration of prairie raptor habitat needs into prairie conservation programs and land-use planning processes.

3. Education and communication: Educate landowners and other key audiences about prairie falcon ecology, habitat requirements, habitat management strategies, breeding habitat and sensitivity to disturbance during nesting. Provide these groups with the knowledge and tools to reduce the effects of their activities on prairie falcons.

4. Research: Address knowledge gaps in prairie falcon ecology relevant to maintaining the population and seasonal breeding range in Alberta.

3.0 MANAGEMENT ACTIONS

3.1 Inventory and Monitoring

The distribution and population trend of prairie falcon populations in Alberta are monitored principally by using data collected during peregrine falcon surveys. Such data are valuable but the primary focus is peregrine falcons. Data from Oldman Reservoir, Pine Coulee and Bow River subpopulations have also contributed to assessing population trends. The post-construction monitoring of prairie falcon nesting activity and productivity has now been completed by Alberta Environment at the Oldman River Reservoir and Pine Coulee Reservoir. The only remaining monitoring effort is undertaken by volunteers along the Bow River (Campbell pers. comm.).

To understand prairie falcon population trends, and determine why the number of nesting pairs has declined in some areas, the following steps are recommended:

- Identify breeding subpopulations and evaluate the levels of risk to each one.
- Using a subset of the prairie falcon nesting pairs in different subpopulations, develop a monitoring program which collects data to document trends of occupancy and productivity of prairie falcons at traditional nest sites (minimum sample size). This would increase the knowledge needed to specifically assess prairie falcon population trends over time. Subpopulations with longterm data should be included in the monitoring program as a minimum (see next recommendation).
- Continue long term monitoring of the breeding subpopulations of prairie falcons on the Bow River, Oldman River Reservoir, and Pine Coulee Reservoir, where data have been collected regularly for at least 10-20 years. Monitoring every two

years is essential and economically practical for understanding the population trends of prairie falcons in Alberta and to assess the status of the population.

- Incorporating observations of nesting prairie falcons during aerial surveys for peregrine falcon nesting success would strengthen the subsample monitoring efforts and provide a broader perspective across the province of prairie falcon nest site occupancy and population trends.
- Every five years, review monitoring data to determine if any subpopulations are in decline. If they are, management actions should be undertaken.
- Capture prairie falcon nesting success data in the Fisheries and Wildlife Management Information System.

3.2 Habitat Management

The close association of prairie falcons with native grasslands in Alberta is well understood (Steenhof 1998, Paton 2002), as is the value of moderate grazing of cattle in maintaining habitat quality for grassland prey species (Michener 1996). During breeding, prairie falcons select a cliff nest site along lentic or lotic systems that occur in the Grassland Natural Region or, in a few cases, the Rocky Mountain Natural Region. Once post-fledging of young prairie falcons occurs, the falcons expand their home ranges searching for pockets of prey species across the surrounding landscape.

Conservation of habitat for prey species such as ground squirrels and grassland birds through habitat management is essential to prairie falcons persistence. However, the cumulative impact to prairie falcons of anthropogenic alterations to grasslands is not well understood. Support and implementation of multi-species studies and incorporation of their findings into land-use planning will be a useful way to ensure the proper management of prairie landscapes for prairie falcons and other grassland wildlife in Alberta.

The best option for habitat conservation is on a broad scale through policies and practices that prevent the loss of native grasslands to other land uses (i.e., no net loss of native grasslands), or that maintain existing grasslands in a condition suitable for wildlife (Environment Canada 2008). The following practices should be followed to conserve prairie falcon habitat and their prey base:

1. Maintain and enhance a grassland conservation policy for ESRD, similar to the Foothills Fescue PNT: Information letter 2009-04 Foothills Fescue Grassland Information Letter - Principles for Minimizing Surface Disturbance.
2. Maintain healthy rangelands, with the understanding that a mosaic of grazing disturbances will benefit a variety of wildlife species including prairie falcons.
3. Limited use of chemical ground squirrel control agents.

3.2.1 Timing and setback recommendations

Existing provincial land use guidelines addressing timing windows (April 15 to July 15) and setback distances of 1000 m from existing nest sites need to be consistently applied, and improved as better information becomes available. ASRD-FWD and Lands Sensitive Species Setback Distances and Timing restrictions for land use developments on both

private and public lands (ASRD-FWD 2009) should be used in all developments. Recent research supports expert opinion (Steenhof 1998, ASRD-FWD 2009) for maintaining a 1000m buffer around prairie falcon nest sites (Paton 2010). Based on telemetry data of prairie falcon habitat use during incubation and young rearing collected over a two year period, female falcons spent a majority of their time foraging within 1000m of the nest site (n = 3; Paton 2010). No data for male prairie falcons or fledglings are yet available from this study.

3.2.2 Nest site creation

Nest site enhancement/creation can be used as a means of off-setting losses of pairs throughout some parts of the breeding range; however, this is not an alternative to maintaining suitable habitat, which is paramount for prairie falcon survival. The only prairie falcon nest holes/ledges in Alberta that can be considered 'permanent' are those in sandstone formations (mostly in the western part of the bird's range in Alberta and on the Milk River). Throughout a large part of the rest of the range, holes that are in clay cliffs are largely ephemeral. Therefore, digging small holes in durable parts of cliffs (that lack suitable nesting sites) creates new nesting sites (holes created in soft substrate will require maintenance), the lack of which can limit prairie falcon populations (Newton 1979). New nest sites should be created within 1 km or less of ground squirrel populations. Members of the falconry community and licensed bird banders could be approached to help with creating and monitoring nest sites.

3.3 Education and Communication

The fast flight of prairie falcons is impressive to observe, but is rarely viewed by the public, nor do many Albertans recognize the important role of raptors in the prairie ecosystem. Programs promoting an understanding of prairie grassland dynamics (including the value of prairie falcons to control ground squirrel populations) to the general public, school groups and landowners should continue and be increased. Communication with landowners, recreationalists and industry, especially regarding timing and setback guidelines, is important to decrease disturbance to prairie falcons during egg laying, incubation and fledging of young.

3.4 Research

Identify and investigate knowledge gaps important to understanding prairie falcon population trends such as:

- Increase the knowledge of post-fledgling survival of prairie falcons and their dispersal success.
- The core subpopulations of prairie falcons are patchy in their distribution creating a situation where metapopulation dynamics such as immigration and emigration of individuals is important to population status. Further research is needed to evaluate the extent of genetic exchange between subpopulations
- Determine habitat characteristics for both declining and stable subpopulations at multiple scales.
- Little is know about prairie falcon habitat use during the summer and fall seasons. Additional information is also needed on post-breeding habitat use.

- Promote research on the impacts of climate change on grassland raptors, their prey and habitat.

4.0 SUMMARY

Research in North America indicates prairie falcons are negatively affected by human development and conversion of grasslands to agriculture, urban development and industrialization. On their foraging range, these falcons are able to utilize and adjust to small scale developments, and during winter are able to take advantage of congregations of prey species such as horned larks in large areas of cropland. Even though the prairie falcon is adaptable there has been a significant reduction to their habitat in Alberta (Kirk and Bansch 1996). Although the population appears stable, the number of pairs has decreased in some areas (Paton 2002, Campbell pers. comm.). A monitoring framework is required to track prairie falcon numbers and the status of traditional nest site use over time. Currently, we lack adequate data to understand prairie falcon population trends. The conservation of prairie falcons in Alberta depends on the availability of suitable breeding habitat. The number of pairs is low in Alberta, with local subpopulation nest site occupancy and productivity displaying much variability between years with a continuing decrease in occupied nest sites, which may reflect population numbers.

Management efforts must carefully focus on preventing loss of a limited supply of high quality nest sites, the continued occupancy of long used traditional nesting sites and the availability of habitat with sufficient prey resources in breeding territories. Such efforts would also have benefits for a broad range of prairie species that depend on similar habitats. Improved communication about the prairie falcon and prairie ecosystems is also required.

This management plan will be reviewed in five years, and may be updated prior to that time if new relevant information becomes available. The review will be lead by FWD, in consultation with researchers and participating agencies.

5.0 LITERATURE CITED

Alberta Endangered Species Conservation Committee (ESCC). 2003. Prairie Falcon Initial Conservation Action Statement. Recommended to the Minister of the Environment. 2 pp.

Alberta Sustainable Resource Development-Fish and Wildlife Division. 2009. Recommended Land Use Guidelines for Protection of Selected Wildlife Species and Habitat within Grassland and Parkland Natural Regions of Alberta- Draft. Alberta Sustainable Resource Development- Fish and Wildlife Division, Internal Document.

Banasch, U. and S.J. Barry. 1998. Raptor Component Report: Canadian Forces Base Suffield National Wildlife Area, Wildlife Inventory. Canadian Wildlife Service, Environment Canada, Prairie and Northern Region, Edmonton, AB. 51 pp.

Beauvais G., J.H. Enderson, and A.J. Magro. 1992. Home range, habitat use and behavior of prairie falcons wintering in east-central Colorado. Journal of Raptor Research 26:13-18.

Bednarz, J. C. 1984. Effect of mining and blasting on breeding Prairie Falcon (Falco mexicanus) occupancy in the Caballo Mountains, New Mexico. Raptor Res. 18:16-19.

Bradley, C., and C. Wallis. 1996. Prairie Ecosystem Management: an Alberta Perspective. Prairie Conservation Forum, Lethbridge, AB. Occ. Pap. No. 29 pp.

Butcher, G. S., M. R. Fuller, and J. L. Ruos. 1987. The populations of seven North American raptors in winter: a Christmas bird count analysis. Unpubl. Rep. to U.S. Fish and Wildl. Serv.

Committee on the Status of Endangered Wildlife in Canada. 2011. COSEWIC's Assessment Process and Criteria. (Online) http://www.cosewic.gc.ca/eng/sct0/assessment_process_e.cfm (Accessed November 4, 2011).

Corrigan, R. 2000. The 2000 Alberta Provincial Peregrine Falcon (Falco peregrinus anatum) survey, December, 2000. Unpubl. Rept., prepared for Alberta Conservation Association and Alberta Environment, Edmonton, AB. 26 pp.

Enderson, J.H. 1964. A study of Prairie Falcon in the central Rocky Mountain Region. Auk 81:332-352.

Environment Canada. 2008. Recovery strategy for the Sprague's pipit (*Anthus spragueii*) in Canada. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa. v + 29 pp.

Fimreite, N., R.W. Fyfe, and J.A. Keith. 1970. Mercury contamination of Canadian prairie seed eaters and their avian predators. Canadian Field-Naturalist 84: 269-276.

Fyfe, R.W. and R. Olendorff. 1976. Minimizing the dangers of nesting studies to raptors and other sensitive species. Canadian Wildlife Service Occ. Pap. No. 23, Edmonton, AB. 17 pp.

Fyfe, R.W., and R.W. Risebrough and W. Walker. 1976. Pollutant effects on the reproduction of the Prairie Falcons and Merlins of the Canadian prairies. Canadian Field-Naturalist 90:346-355.

Fyfe, R.W. 1997. 1997 Raptor monitoring on the Oldman River Reservoir. Prepared for Alberta Environmental Protection, Edmonton, AB. 16 pp.

Harmata, A.R. 1991. Impacts of oil and gas development on raptors associated with Kevin Rim, MT. Rept. prepared for the Bureau of Land Management, Great Falls, MT.

Hunt, L.E. 1993. Diet and habitat use of nesting Prairie Falcons (Falco mexicanus) in an agricultural landscape in southern Alberta. M.Sc. thesis, University of Alberta, Edmonton, AB. 61 pp.

Inouye, D. W., B. Barr, K. B. Armitage, and B. D. Inouye. 2000. Climate change is affecting altitudinal migrants and hibernating species. Proceeding of the National Academy of Science, USA. 97: 1630-1633.

Intergovernmental Panel on Climate Change. 2001. Climate change: The scientific basis. Working Group 1, IPCC Third Assessment Report, Intergovernmental Panel on Climate Change. 94 pp. [http://www.grida.no/climate/ipcc_tar/; accessed November 2011]

International Union for Conservation of Nature (IUCN). 2001. IUCN Red List of Threatened Species: 2001 IUCN Red List Categories and Criteria version 3.1(Online) http://www.iucnredlist.org/technical-documents/categories-and-criteria/2001-categories-criteria (Accessed November 4, 2011).

Kirk, D.A. and U. Banasch. 1996. Updated Status Report on the Prairie Falcon (Falco mexicanus) in Canada. Prepared for the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), Ottawa, ON. 8 pp.

Marzluff, J.M., B.A. Kimsey, L.S. Shueck, M.E. McFadzen, M.S. Vekasy and J.C. Bednarz. 1997. The influence of habitat, prey abundance, sex, and breeding success on the ranging behavior of Prairie Falcons. Condor 99:567-584.

Michener, G.R. 1996. Establishment of a colony of Richardson's Ground Squirrels in southern Alberta. Pp. 303-308 in Proceedings of the Fourth Prairie Conservation and Endangered Species Workshop (W.D. Willms and J.F. Dormaar, eds.). Provincial Museum of Alberta Natural History Occ. Pap. No. 23, Edmonton, AB. 337 pp.

Newton, I. 1979. The population ecology of raptors. A.D. Poyser Ltd., Hertfordshire, England. 399 pp.

Ogden, V. T. and M. G. Hornocker. 1977. Nesting density and success of Prairie Falcons in southwestern Idaho. J. Wildl. Manage. 41:1-11.

Parker, R. C. 1972. Prairie Falcon management in Washington State. Proc. West. Assoc. Game Fish Comm. 52:394-408.

Paton, D. 1999. 1999 Raptor monitoring on the Oldman River Reservoir. Unpubl. Tech. Rept. prepared for Alberta Environmental Protection, Edmonton, AB. 12 pp.

Paton, D. 2002. Status of the Prairie Falcon (Falco mexicanus) in Alberta. Alberta Sustainable Resource Development, Fish and Wildlife Division, and Alberta Conservation Conservation Association, Wildlife Status Report No. 42, Edmonton, AB. 28 pp.

Paton, D. 2009. Pine Coulee Raptor and Ground Squirrel Inventory 2009, and Eight Year Productivity and Abundance Trends (2002-2009). Prepared for Alberta Environment. 34 pp.

Paton, D. 2010. Alberta Wildlife and Wind Energy Workshop. Presented:Raptors and Turbines. Cochrane Alberta, Feb. 10 – 11, 2012.

Peterson, D. L. 1988. Nesting and habitat parameters for selected raptors in the desert of northern Utah. Master's Thesis. Utah State Univ. Logan.

Phillips, R. L., A. H. Wheeler, J. M. Lockhart, T. P. McEneaney, and N. C. Forrester. 1990. Nesting ecology of Golden Eagles and other raptors in southeastern Montana and northern Wyoming. Tech Rep. 26. U.S. Fish Wildl. Serv. Fish Wildl. Washington, D.C.

Redig, P. T., C. M. Stowe, D. M. Barnes, and T. D. Arent. 1980. Lead toxicosis in raptors. J. Am. Vet. Med. Assoc. 177:941-943.

Robbins, M. B., and B. C. Dale. 1999. *Sprague's Pipit (Anthus spragueii).* In *The Birds of North America*, No. 439 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Runde, D.E. 1987. Population dynamics, habitat use and movement patterns of the prairie falcon (Falco mexicanus). Ph.D. dissertation. University of Wyoming, Laramie. 166pp.

Schmutz, J.K., R.W. Fyfe, U. Banasch, and H. Armbruster. 1991. Routes and timing of migration of falcons banded in Canada. Wils. Bull. 103:49-58.

Steenhof, K. 1998. Prairie Falcon (Falco mexicanus). Pp. 28 in The Birds of North America, No. 346 (A. Poole and F. Gills, eds.). The Birds of North America, Inc., Philadelphia, PA.America. Ornithol. Monogr. 20:1-98.

Squires, J. R. 1986. Movements, food habits, and productivity for a small population of Prairie Falcon utilizing oil developed lands, Campbell County, Wyoming. Master's Thesis. Univ. of Wyoming, Laramie

Squires, J. R., S. H. Anderson, and R. Oakleaf. 1993. Home range size and habitat-use patterns of nesting Prairie Falcons near oil developments in northeastern Wyoming. J. Field Ornithol. 64:1-10.

List of Titles in the Alberta Species at Risk Conservation Management Plan Series
(as of October 2012)

No. 1 Long-toed Salamander Conservation Management Plan, 2010-2015.

No. 2 Sprague's Pipit Conservation Management Plan, 2010-2015.

No. 3 Long-billed Curlew Conservation Management Plan, 2010-2015.

No. 4 Harlequin Duck Conservation Management Plan, 2010-2015.

No. 5 Wiedemeyer's Admiral Conservation Management Plan, 2012-2017.

No. 6 Western Small-footed Bat Conservation Management Plan, 2012-2017.

No. 7 White-winged Scoter Conservation Management Plan, 2012-2017.

No. 8 Bull Trout Conservation Management Plan, 2012-2017.

No. 9 Prairie Falcon Conservation Management Plan, 2012-2017.